A-22

Mirco-SXRF Imaging of Transition Metal Distributions in the Brains of Rats after Chronic Mn Exposure and Healthy Controls

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Although manganese (Mn) plays a vital role for normal development and body function of all mammals, excessive Mn exposure produces symptoms resembling those of idiopathic Parkinson's disease. Manganese is known to pass across the blood-brain barrier and interact with neurons. However, the knowledge on molecular mechanisms of its neurotoxicity remains incomplete. There are indications that exposure to Mn affects homeostasis of iron in the brain.

We used x-ray fluorescent imaging to quantitatively examine changes in distribution of biologically relevant metals (Ca, Mn, Fe, Cu and Zn) in selected areas in the brain (cortex, caudate putamen, globus pallidus, and hippocampus) in the condition of chronic exposure to Mn. We found that Mn accumulates preferentially in caudate putamen, globus pallidus, and hippocampus. Iron (Fe) content is elevated in most areas in the brain affected by chronic exposure to Mn. The largest difference in Fe content was determined inside ventricles—areas filled with choroid plexus cells and cerebrospinal fluid (CSF). This is in agreement with earlier studies that demonstrated considerable (+167% or threefold) increases of Fe in CSF. Thus, excessive accumulation of Mn in brain cells as well as altered Fe content may contribute to neurotoxic effect of Mn.